Spin Fluctuation and Mass Reduction of a Carrier Pair as the Gauge Fields in a Nearly Antiferromagnetic Background

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Effect of Gauge Fields on Nuclear Magnetic Relaxation Rate and Spin Susceptibility

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Effect of gauge fields representing the local constraints and the phase fluctuation of the bond order parameters are investgated for the fluxless states which was recently proposed by Nagaosa and Lee as a possible model for high T_c oxides. If the system is clean, both spin susceptibility and NMR rate are found to be essentially independent of temperature, whereas in a dirt case the former increases in proportion to the inverse temperature.

Normal State Properties of the Uniform Resonating Valence Bond State

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高温超伝導体の発見以来，精力的な実験的，理論的研究により，フェルミ流体論で記述される通常の金属電子とは異なった性質が明らかにされてきた。その中でも最も注目を集めているのがAnderson の提唱した RVB 状態と spin-charge の分離及びそれにともなう物性である。本講演では，種々の RVB 状態のうち Uniform RVB を考え，そこからの揺ぎをゲージ場により扱い，各種物理量を計算することにより温度に比例する抵抗等，実験に合う結果を出すことが出来ることを示した。又，輸送係数，スピン帯磁率，中性子散乱，Photoemission spectroscopy など見る物理量によりspin-charge 分離が異なった形で表われることを強張した。

Spin Fluctuation and Mass Reduction of a Carrier Pair as the Gauge Fields in a Nearly Antiferromagnetic Background

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A system of holes or excess electrons created in a two-dimensional electron lattice with alternating spin alignment is considered. In the hole system the charge carriers

are fermions with enhanced mass. In the electron system the mass enhancement for the excess electrons is even more serious. In both cases a bond pair of such fermions is always formed in the ground state. The bound pair acquires a small mass. Hence the condensed state of the composite bosons, the bound pairs, is achieved in the lower temperature phase. The mass reduction in the pair formation is described by a Gauge force. This is clearly expressed by means of the Schwinger spin bosons. The Gauge force leading to the mass reduction appears in a very local ragion. The asymptotic freedom leads to a partial justification for our mean field picture which neglects the quantum spin fluctuations. The Néel spin pattern in the background may not be a good approximation for $T>T_c$, but in the superconducting phase the spin pattern is almost stabilized through the mass reduction mechanism. The spin pattern violates the time reversal symmetry. As the CPT theorem predicts, there appears a parity violation:The bound pair is a mixture of a symmetric state and an odd parity state. The conventional GL phenomenological theory does not apply to this novel superconductivity.

Resonating-Valence-Bond Ground State in a Large-n t-J Model

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To shed light on the roles of hole doping in strongly interacting elctron systems, we study large-n version of the t-J model. When there are holes we prove that a novel resonating-valence-bond(RVB)state, which we call the hopping-dominated RVB (hRVB) state, is the unique ground state. We conjecture the existence of a phase transition between the standard tunneling-dominated phase and the new hopping-dominated phase. By treating the hopping term in the second order perturbation, we get an exactly solvable toy model whose ground state is the nearestneighbor hRVB state.

A Weak Coupling Expansion for the Hubbard Model on a 4×4 Cluster

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The Hubbard model on a 4×4 cluster is studied in the weak coupling limit for half filling one and two holes. In the half filled case and for one hole the quantum numbers of the ground state agree with moderately strong coupling results. In the two hole case, to second order in U, there is more degeneracy than at intermediate coupling. The binding